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SUPPLEMENT TO
SOVIET GEODETIC PHOTOGRAMMETRIC
INSTRUMENTATION

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INTRODUCTION

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25X1A5a1 The following report is submitted as a supplement to [REDACTED]

[REDACTED] "Soviet Geodetic and Photogrammetric Instrumentation". This supplement is forwarded for the use of technical personnel in the fields of photogrammetry, geodesy, photography and, to a lesser degree, for technicians working in the field of map reproduction.

The report consists of lists of references where detailed, operational diagrams, photographs, optical systems, etc. of instruments used by the Soviets in the above-mentioned sciences may be found in Soviet scientific literature.

Seven, recent Soviet references were selected as being most significant for the purpose of this report. They are as follows:

- I. Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952..... 3
- II. Drobyshev, F.V., Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951 21
- III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem. (The Rating Methods of Complicated Photographic Systems). OGIZ 1948 30
- IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952 36

- V. Katalog - Spravochnik Laboratornykh Priborov i
Oborudovaniya. Vypusk 34. Mashgiz, 1949 43
- VI. 20th Anniversary of Soviet Geodesy and Cartography,
1919-1939. (Dvadtsat' Let Sovetskoy Geodezii i
Kartografii, 1919-1939.) 50
- VII. Shershen', A.I., Aerofotos"yemka, Letnos"yemochnyy
Protsess (Aerial Photography, Aerial-Surveying Process).
Izdatel'stvo Geodezicheskoy i Kartograficheskoy
Literatury, Moskva, 1949 52

Subject: Pictures of Photographic and Photogrammetric Instruments and Designs and Graphs of Operational Characteristics of Main Optical Systems, as Abstracted from Soviet Sources.

Source I: Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952.

Reference to Text Description	Figure or Table No.	Page on Which Fig. or Table is Found	Information Available
Page 35, Section 8	Fig. 10-e	Page 21	Detail Drawing of the "Ortogoz" Objective. Camera, "Fotokor" is equipped with this objective; it is an uncemented four-lens anastigmat. Data: Focal Length: 13.5 cm. Relative Aperture: 1:4.5 Field of View: 55°
Pages 35-36	Fig. 10-d	Page 21	Detail Drawing of the "Industar" Objective (of which there are several). This is an unsymmetrical semi-cemented anastigmatic objective. It is manufactured in various focal lengths.
Page 36	-	-	"Industar - 11" Objective (No picture). Used in reproduction cameras. These objectives are manufactured with focal lengths: 21, 30, 60, 90, and 120 cm. Relative Apertures: 1:4.5 for small cameras 1:9 for large cameras

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 36	-	-	<p>"Industar-22" Objective. (No picture).</p> <p>Data: Focal Length: 50 mm.</p> <p>Relative Aperture: 1:3.5</p> <p>Field of View: 46°</p> <p>Resolving Power, in Center of Field: 40 lines;</p> <p>Resolving Power, at Edge: 20 lines.</p> <p>Used in cameras, "FED" and "Zorkiy".</p>
Page 37	-	-	<p>"Industar-23" Objective (No picture).</p> <p>Data: Focal Length: 110 mm.</p> <p>Relative Aperture: 1:4.5</p> <p>Field of View (Diagonally): 52°</p> <p>Used in camera, "Moskva II"</p>
Page 37	Fig. 21	Page 36	<p>Detail Drawings of External View and Diagrams of Internal Arrangement of Lenses of "Yupiter" Objectives for "Kiyev" Photo-apparatus. (Camera)</p>
Page 37	Fig. 21-1	Page 36	<p>"Yupiter 3" Objective.</p> <p>Data: Focal Length: 50 mm.</p> <p>Field of View: $\approx 45^\circ$</p> <p>Relative Aperture: 1:1.5</p>

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
	Fig. 21-2	Page 36	"Yupiter-8" Objective. Data: Relative Aperture: 1:2 Field of View: 45°
	Fig. 21-3	Page 36	"Yupiter-9" Objective. Data: Focal Length: 85 mm. Relative Aperture: 1:2 Field of View: 28°
	Fig. 21-4	Page 36	"Yupiter-11" Objective. Data: Focal Length: 135 mm. Relative Aperture: 1:4 Field of View: $\approx 13.5^{\circ}$
	Fig. 21-5	Page 36	"Yupiter-12" Objective. (A wide-angle an- astigmatic objective with field of view of 63°) Data: Focal Length: 35 mm. Relative Aperture: 1:2.8
Page 37	Fig. 22	Page 37	Detail Drawings of External View of Objec- tives for "FED" Cameras.
	Fig. 22-b	Page 37	Universal ("Universal'nyy") Objective for "FED". Data: Focal Length: 50 mm. Relative Aperture: 1:3.5 Field of View: 55°

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 37	Fig. 22-v	Page 37	High Light Power ("Svetosil'nyy") Objective. Data: Relative Aperture: 1:2 Remaining Characteristics: Same as for the Universal Objective (above).
Page 37	Fig. 22-a	Page 37	Wide-angle ("Shirokougol'nyy") Objective. Data: Focal Length: 28 mm. Relative Aperture: 1:4.5 Field of View: 76°
Page 37	Fig. 22-d	Page 37	Teleobjective ("Teleob'yektiv"). Data: Focal Length: 100 mm. Relative Aperture: 1:6.8 Field of View: 24°
Page 38	Fig. 22-g.	Page 37	Reproduction ("Reproduktсионnyy") Objec- tive. This objective "has the same char- acteristics as the Universal Objective, but the objective's mounting is made in the form of two pipes, moving one in the other, which makes it possible to move the objective rather far out from the light sensitive coating and make an exposure from a distance of 15 cm., increasing by this means the scale of the representation up to 1:2, which it is not possible to do with the ordinary "FED" objective."

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 38	Fig. 23	Page 38	Diagrams of Internal Arrangement of Lenses of Aerial Surveying Wide-angle Objectives. Note: No further data is given.
-	Fig. 23-a	Page 38	"Russar-19" Objective.
-	Fig. 23-b	Page 38	"Russar-25" Objective.
-	Fig. 23-v	Page 38	"Russar-29" Objective.
-	Fig. 23 g	Page 38	"Rodina-2" Objective.
-	Fig. 23-d	Page 38	"Russar-31" Objective.
Page 38	Fig. 24	Page 39	Design of Mirror-Lens Objectives. 1. Meniscus, 2. Mirror, 3. Concave Mirror, 4. Focal Plane.
Page 38	Fig. 25	Page 39	Pictures (External View) of Various Types of Objective Mounts.
Page 38	Fig. 25-a	Page 39	"Industars", used for reproduction, have the so-called normal mount which is located entirely outside of the camera. ("Normal'- naya oprava").
Page 38	Fig. 25-b	Page 39	Sunken ("Uglublennaya") Mount. For port- able and miniature cameras, in which the mount only partly extends outside.
Page 38	Fig. 25-v	Page 39	Sunken with Shutter ("Uglublennaya s zatvorom") Mount.)

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 38	Fig. 25-g	Page 39	Worm-screw ("Chervyachnaya") Mount. Used in those cases where the focusing is done by moving the objective along the optical axis.
Page 49	Fig. 40	Page 49	<p>Pictures (External View) of the "AFA-33" Series of ("Aerofotoapparat") Aerial-Photo-Apparatuses = Cameras and Attachments. These apparatuses are "with cones for objectives with various focal lengths. In the case of very short-focus apparatuses the cone is lacking. The objectives have a between-the-lens shutter, the threshold speed of which rarely exceeds 1:120 sec. Curtain-slot shutters for apparatuses, intended for precision operations, are used rarely, in view of the distortions produced by them."</p> <p>The apparatuses of this series shown in Fig. 40 include the following: "AFA-33/100," "AFA-33/75," "AFA-33/50," "AFA-33/20."</p> <p>The labelled parts indicated are as follows: 1. camera section; 2. cone; 3. cassette; 4. electric power unit; 5. control</p>

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
			device; 6. electric cord; 7. light filter; 8. mounting; 9. Cardan roller; 10. flexible rod.
Pages 50-51	Figure 41	Page 50	Detail Drawing of the Kinematic System of an Aerial-Photo-Apparatus (Camera and Aux- iliary Parts). Parts are labelled, No. 4 is a "Zhalyuzi" ("Jalousie") Shutter.
Page 52.	Fig. 42	Page 51	Design of a Slit ("Shchelevoy") Aerial- Photo-Apparatus. (Labelled Parts: 1. "Rus- sar" F - 70. 2. "Plazmat" F - 210.
Page 83	Fig. 56	Page 83	Design of Golberg's ("Gol'dberga") Denso- graph ("Denzograf"). Labelled Parts.
Pages 83-84	Fig. 57	Page 84	Detail Drawing of Densitometer of GOI. Labelled Parts.
Page 85	Fig. 58	Page 84	Detail Drawing of Polarized Martens Den- sitometer.
Pages 85-86	Fig. 59	Page 86	Detail Drawing of Sensitometer of GOI. Parts are labelled in both Fig. 58 and Fig. 59.
Page 87	Fig. 60	Page 87	Detail Drawing: A Developing Device (Not named).
Page 87	Fig. 61	Page 88	A Sensitometric Graph (GOST-2817-45, Soviet Russian System of Sensitometry). (Note: This system, GOST-2817-45, is described on pages 85-91.)

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 87	Fig. 62	Page 38	Characteristic Set of Curves (GOST-2817-45, Soviet-Russian System of Sensitometry).
Page 88	Fig. 63	Page 89	Characteristic Curve, (GOST-2817-45, Soviet-Russian System of Sensitometry).
Page 91	Fig. 64	Page 91	Determination of the Value γ of the Coefficient of Contrast.
	Fig. 65	Page 92	Connection Between ΔD , γ and U.
	Table 11	Page 93	Values of Recommended Coefficient of Contrast for Different Types of Photographic Materials.
	Fig. 66	Page 92	Curve of Dependence of S, D_0 and γ on the Time of Developing (Development Time).
	Fig. 67	Page 94	Juxtaposition of Luminosity Intervals and Photographic Width.
	Fig. 68	Page 96	Different Methods of Indicating Sensitivity.
	Fig. 69	Page 96	Sensitivity's Dependence Upon the Form of the Characteristic Curve.
	Table (No number)	Page 98	Table of Sensitivity Issued by the Main Directorate of the Motion Picture Film Industry.
	Fig. 70	Page 99	Sensitometric Parameters of Photographic Paper.
	Fig. 71	Page 100	Test Object for Paper Examination.

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
	Fig. 72	Page 101	Spectrograph.
	Fig. 73	Page 102	Spectrograms of an Orthochromatic Film.
	Fig. 74	Page 102	Spectrosensitometer.
	Fig. 75	Page 103	Curves of Spectral Sensitivity of Different Sensitive Materials.
	Fig. 76	Page 104	Color Table.
	Fig. 77	Page 104	Color Table.
	Fig. 78	Page 106	Curve of Filtration through the Light Filter.
	Fig. 79	Page 107	Different Types of Light Filters (Diagram).
	Fig. 80	Page 107	Spectral Characteristics of Some Light Filters (Diagram).
	Fig. 81	Page 109	Elements of Spectral Curve of Light Filters and Table 12.
	--	Page 110	Table 13. Filtration Power of Different Light Filters.
	Fig. 82	Page 111	Relation of Different Sensitive Emulsions to the Rays of Various Wave Lengths.
	--	Page 111	Table 14. Absorption Power ("Kratnost") of Aerial Survey Light Filters for Films.
	--	Page 112	Table 15. Absorption Power of Light Filters of Films for Land Survey.

Page No.	Figure No.	Information Available
114	83	Curves of Dependence of Granularity g on Coefficient of Contrast, γ and Optical Density D .
115	84	Aureoles: a - Diffusion, δ (b) - Reflection.
116	85	Burmistrov's Resolvometer ("Rezol'vometr F. L. Burmistrova").
117	86	Test Object (Mira).
119	--	Unnumbered Table: Thickness of Emulsion for Plates, Films and Papers.
120	87	Microphotograph of Emulsion grains of Different Emulsions.
121	--	Table 16. Table Showing Characteristics of Various Emulsion Coatings.
122	88	Curve of Disposition of Emulsion by Grain Size.
122	89	Scheme of a Process for Production of Emulsion.
124	90	Spectrograms of Different Sensitized Emulsions Obtained During Lighting with 1/2 Watt Bulb.
126	--	Table 17. Classification and Sensitometric Features of Photographic Plates.
129	91	Cross Section of Present-Day Negative of a Motion Picture Film.
130	--	Table 18. Sensitometric Characteristics of Photographic Films.
130	--	Table 19. Coefficients of Contrast.
132	--	Table 20. Sensitometric Characteristics of Motion Picture Film.
135	--	Table 21. Photographic Papers, 6 Kinds.

Page No.	Figure No.	Information Available
136	--	Table 22. Classification and Sensitometric Characteristics of Photographic Papers.
136	92	Scheme of Printing on Reflex Paper.
144	--	Table 23. Day Lighting for Different Heights of the Sun and Cloudiness without Snow (In Lux Thousands) (or Meter-candle Thousands - Unit of Illumination).
145	93	Diagram of Illumination in Cloudy and Bright Weather, Depending on Sun's Height Above the Horizon.
146	--	Table 24. Day Lighting for Different Heights of the Sun and Cloudiness with Snow (in Lux or Meter-candle Thousands).
147	--	Table 25. Time and Lighting.
148	94	Change of Lighting at Small and Negative Sun Heights.
148	95	Distribution of Energy for Dispersed and Summary Radiation.
149	96	Curves of Spectral Distribution of a Dispersed Radiation of Daylight.
150	97	Spectral Distribution of Energy by the Spectrum.
150	98	Distribution of Energy by the Spectrum.
152	--	Table 26. Coefficients of Brightness of Different Objects.
154	99	Spectrometric Characteristics of Land Formations by Ye. L. Krinov (Diagram).
155	100	Spectrometric Characteristics of Vegetation (Diagram).
156	--	Table 27. Coefficients of Brightness of Green Objects (Spruce, Birch, Aspen, Dry Meadow).
159	--	Table 28. Reflection Coefficients of a Forest and a Road.
162	--	Table 29. Change of the Atmospheric Pressure Depending on the Height.

Page No.	Figure No.	Information Available
163	101	Diagram Showing the Change of Mass of Atmosphere with Increase of the Height.
164	102	Change of the Atmospheric Mass with Change of Sun's Height.
165	103	Diagram. Change of Coefficient of Transparency for Different Wave Lengths.
166	104	Transparency of Water Vapors for Infra-red Rays.
166	105	Dependence (Interdependence) Between the Optical Thickness of the Atmosphere τ and the Coefficient of Transmission of the Atmosphere T . (Diagram).
167	--	Table 30. Values of Spectral Characteristics of the Optical Mass τ for Different Heights.
168	106	Indicatrix of Dispersion of Light for the Ideal Atmosphere.
169	--	Table 31. Characteristics of the Atmosphere by Farness of Visibility, Coefficient of Transmission in the Visible Part of the Spectrum and Corresponding Evaluation of Atmospheric Conditions.
170	107	Indicatrix of Dispersion in Good and Bad Visibility.
172	108	Diagram Showing the Change of Haze Brightness in Connection with Change of the Atmospheric Mass.
174	--	Table 32. Shows Atmospheric Haze's Increase Proportional to the Optical Thickness of the Atmosphere.
176	--	Table 33. Effective Optical Thickness of the Atmosphere for Different Photographic Materials and Light Filters.
176	--	Table 34. Values of the Effective Optical Thickness of the Atmosphere for Oblique Aerial Surveying from Different Heights.

Page No.	Figure No.	Information Available
178	109	Design of a Device for Determination of Light Dispersion.
181	--	Table 35. Coefficients of Losses K_0 and K_p and K_3 for Cameras AFA-13, with "Industar-13" Objective, AFA-I with "Industar-51" Objective, RMK with "Russar-25" Objective, and K-17-B, with "Metrogon" Objective.
183	--	Table 36: Values of a Coefficient of Light Dispersion for 7 Different Cameras: 1) "Fotokor", Objective - "Ortogo" $f = 135$ mm; 2) "FED", Objective with $f = 50$ mm. (Not named); 3) "Elmar", Unnamed Objective with $f = 35$ mm.; 4) "Road Camera", with "Russar-19" Objective, and Lens Shade ("Ottentel"); 5) The Same without Lens Shade; 6) AFA-98, Objective - "Russar-1" and Lens Shade; 7) AFA-98, without Lens Shade.
184	110	Influence of Light Dispersion on the Characteristic Curve.
186	111	Resolving Power of Photographic Material for Test Object with a Changeable Contrast.
186	112	Influence of Location of Density of Image on the Characteristic Curve for the Resolving Power of a Sensitive Coating.
187	113	Connection Between Resolving Power and Contrast Range of the Test Object.
190	114	Dependence (Interdependence) Between Admissible Displacement of Image and Scale of the Aerial Photograph.
192	115	Photo-electric Aerial Exposure Meter. (Picture of External View).
193	116	Substance of Nomographic Method for Calculation of Luminosity.

Page No.	Figure No.	Information Available
194	117	Front and Back Views of the AEN-IV Exponometer.
197	118	Change of the Optical Mass of the Atmosphere in a Perspective (Oblique) Survey.
200	--	Table 37. Exposures for Photographing Submerged Objects.
201	119	Spectral Coefficient of Brightness for Deciduous and Coniferous Forests.
202	120 a and b	Aerial Photographs in Visible and Infrared Zones of the Spectrum.
203	121	Location of Light Source in Night Aerial Photography.
204	122	Sensitometric Curves of Aerial Films with Different Photographic Width for Night Aerial Surveying. (Chapter 7: Reproduction Photography).
224	126	Field Set-up for Photographing of a Mosaic.
225	127	Small Reproduction Camera (Diagram) (Not named).
225	128	Picture of External View of Reproduction Camera of "Bol'shevik" Factory.
226	129	Picture: Wooden Reproduction Camera, (Not named).
226	130	Picture: Two-chamber Camera, (Not named).
227	131	Picture: Vertical Reproduction Camera (Not named).
228	132	Picture: Universal Photostat Apparatus (Not named).
228	133	Inversion of Images (Diagram).
230	--	Table 41. Relation of Blue, Green and Red Rays.
232	--	Table 42. Minimum Assortment of Polygraphic Films.
233	134	Spraying Table for Plates, (Diagram).

Page No.	Figure No.	Information Available
233	135	Drying Chamber for Plates, (Diagram).
236	136	A Grating (or Screen) (Diagram). (Chapter 8: Theory and Practice of the Negative Process).
243	137	Successive Phases of Crystal Development.
243	138	Developed Crystal of Haloid Silver Enlarged 30,000 times.
244	139	Photolysis of Silver Bromide.
246	140	Design Showing Process of AgBr Restoration.
247	141	Microcuts Through the Developed Coating in the Process of Developing.
247	142	Scheme of Development of Emulsion Coating.
252	143	Solubility of Silver Bromide in Solutions of Sulfite.
257	144	Displacement of the Characteristic Curve Under the Influence of Potassium Bromide. (Graph).
265	145	Developing Device with Crimps (Diagram).
266	146	Picture of External View of Spiral Developing Device (Spiral and Winding Stand).
266	147	Diagram of Conical Spiral.
266	148	Diagram of Spiral Device with Rods.
267	149	Diagram of External View of Developing Device with Rewinding of Films.
268	150	Diagram of External View of Developing Device, Automatic.
269	151	Lines of Equal Density of the Negative, Developed in a Cuvette.
269	152	Forming of Strips under the Dark Parts of the Negative.
270	153	Graph: Mikhaylov's Nomogram.

Page No.	Figure No.	Information Available
274	154	Graph: Influence of Benzo-triasole.
275	155	Scheme of Developing Process with Conversion.
276	156	Graph: Influence of Size of Crystals of Silver Haloid on Fixing Speed.
277	157	Comparative Speed of Fixing of Negative and Positive Emulsions.
280	158	Electrolytic Bath of NIKFI.
281	159	Influence of Speed of a Water Flow on Completeness of Washing.
282	160	Influence of Salting on Speed of Film and Print-washing.
282	161	Influence of Temperature on Speed of Film and Print-washing.
284	162	Change of Residual Quantity of Thiosulfate in Paper During Washing.
285	163	Diagram or Detail Drawing of Drying Drum.
286	164	Diagram of Spiral Drier.
286	165	Diagram of Slot Drier.
289	166	Design of Field Densitometer.
290	167	Field Sensitometric Graph.
292	168	Graph: Different Types of Clearing Agents.
298	169	Determination of Deformation. (Chapter 9: Theory and Practice of the Positive Process).
303	170	Correlation Between $\lg B_0$ and $\lg B_{pos}$.
304	171	Connection Between $\Delta \lg B_0$, ΔD_{neg} . and ΔD_{pos} .
306	172	Graphical Method for Construction of the Curve of Reproduction.
308	173	Construction of a Curve of Reproduction for a Particular Case.
308	174	Connection Between ΔD and L .

Page No.	Figure No.	Information Available
310	175	Determination of Maximum Time for Developing.
311	176	Pneumatic Copying Frame, Picture of External View.
312	177	Design of Copying Device.
313	178	Three Different Types of Printing Machines, Pictures of External Views.
317	179	Different Types of Illuminators, Diagrams.
320	180	Diagram: A Diminisher.
323	181	Diagram: A Washer for Paper.
324	182	Drawing of External View of a Drier for Paper.
324	183	Picture of External View of a Glossing Device.
330	184	Diagram: Developing of Diazo-paper by Ammonia.
332	185	Diagram: Transferring by the Ozobrom (?) ("Ozobromnyy") Process. (Chapter 10: Basis of Color Photography).
335	186	Spectral Sensitivity of Color Perceptible Elements of the Eye.
336	187	A Color Triangle.
337	188 a, and b.	Additive and Subtractive Synthesis of a Color.
339	189	Scheme of Subtractive Process.
340	190	A Color-dividing Camera.
342	191	Diagram: Scheme of Construction of a Multi-coated Film and Paper.
344	192	Characteristic Curves of Colored Films.
346	193	Curves of Filters Used in Colored Photographing.
348	--	Table 43: Light Filters and Coefficients of Increase of the Exposure.

Page No.	Figure No.	Information Available
348	195	Scheme for Obtaining of Colored Image on Three-Coated Films with Conversion and Simultaneous Colored Developing.
349	--	Table 44. Processing of 3-coated photographic Materials.
350	--	Table 45. Change of Contrast Range in Separate Coatings.
352	196	Influence of Different Conditions of Processing on γ and D.
355	197	Device for Lighting of Reversible Aerial Film, Picture of External View.
356	--	Table 46: Maximum of Spectral Curve.
359	198	Diagram and Picture of External View of a Multiplier.
360	199 a and b	Lighting Block of Colored Copying Device. Exterior View of the Copying Device.
361	200	Device for Processing of Paper Prints. PRESCRIPTIONS.
364-369	--	Formulas and Components of Solutions.

Source II. Drobyshev, F.V.: Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951

Section 3: Optical Systems in Photogrammetric Devices

Page Figure

26 13 Projection Objectives. Detail Drawing: "Ortoniar" $f = 100$ mm.
"Dagor" 1:6,8 $f = 180$ mm. "Tessar" 1:4,5 $f = 200$ mm.

26 14 Objectives and Lenses of Sighting ("Vizirnykh") Systems.

32 26 Detail Drawing of "Optical system for obtaining Luminous Mark in Stereoplanigraf SPB".

Section 4: Rectifying Devices.

46 33 Design of Autocollimator (Avtokollimator)

47 34 Detail Drawing of Goniometer ("Goniometr")

Section 6: Devices for Photo-rectification.

60 39 System of Photo-rectifier $S_2 O$ ("Fototransformator")

61 40 System of Photo-rectifier $S_2 m$ ("Fototransformator") $S_2 m$

61 41 System of Photo-rectifier $S_2 O_1$ ("Fototransformator") $S_2 O_1$

62 42 System of Photo-rectifier $S_2 R$ ("Fototransformator") $S_2 R$

70 43 Detail Drawing: "Part of Negative's Carriage of Photo-rectifier (Fototransformator) FTH".

71 44 Detail Drawing: "Condenser of Photo-rectifier (Fototransformator) MG1"

Section 9: Automatization of Scaled Coupling.

73 45 Detail Drawing: "Rombic Inverter" ("Rombicheskiy Inversor")

74 46 Detail Drawing: "Angular Inverter".

74 47 Detail Drawing: "Angular Inverter", having Form of a Ruler in Photo-rectifiers of Broken Design.

<u>Page</u>	<u>Figure</u>	
75	48	Detail Drawing: Tape Inverter.
75	49	Design of Device with Tape Inverter.
77	50	Detail Drawing of Gaged Inverter.
		Section 10: Automatization of Perspective Coupling ("perspektivnogo sopryazheniya")
79	51	Detail Drawing of "Tangent" ("Kasatel'naya") Inverter.
80	52	Detail Drawing of Linear Perspective Inverter ("Lineynyy Inversor")
81	53	Detail Drawing: Simplified Perspective ("Perspektivnyy") Inverter.
82	54	Detail Drawing: "Broken-perspective Inverter" ("Uproshchennyy Perspektivnyy Inversor")
83	56	Design of "Tangential-perspective Inverter" ("Skhema Tangentsial'nogo-Perspektivnogo Inversora")
		Section 11: Constructions of Photo-reducers and Photo-rectifiers. ("Konstruktsii fotoreduktorov i fototransformatorov")
84	57	Detail Drawing: (External View) Photo-reducer.
87	58	Picture: (External View) Photo-epi-reducer. ("Fotoepireduktor") of F.V. Drobyshev's System.
87	59	Detail Drawing: Pantograph with Plunger and Matrix. ("Pantograf s puansonom i matritsey") (used under the Photo-epi-reducer shown in Fig. 58)
90	60	Detail Drawing (Stripped View) of "Photo-rectifier MG1".
91	61	Design of "Tangent" ("Kasatel'naya") Oblique Inverter.
92	62	Picture of Small Photo-rectifier (FTM).
95	63	Picture of Large Photo-rectifier (FTB). "With labelled parts).

<u>Page</u>	<u>Figure</u>	Chapter 3: Instruments for Linear Stereoscopic Measurements. Section 14: Stereocomparators.
104	65	.Picture: (External View) Horizontal Stereocomparator.
105	67	Detail Drawing: Optical System of Binocular.
106	68	Picture: Oblique Stereocomparator.
107	69	Design of Optical Installation for Reading of Coordinates and Parallaxes in Oblique Stereocomparator. (Labelled parts).
108	70	Drawing: Optical System of Oblique Stereocomparator. (Labelled parts explained in text)
109	71	Picture: (External View) of Stereopantometer of System of F.V. Drobyshev
110	72	Detail Drawing: "Four-mirror Stereoscope of Stereopantometer.
113	77	Design of Convergent Installation of Topographic Stereometer.
116	79	Detail Drawing of Correction Attachment of Topographic Stereometer. (labelled parts)
117	80	Detail Drawing of Transfer of Sighting Ray <u>m</u> in Oblique by Direction <u>vy</u> (movement of binocular's parts is shown by arrows). (Labelled Parts).
118	81	Design of Correctional Device of a Stereometer. (Labelled Parts).
119	82	Detail Drawing: "Left Carriage of a Stereometer."
119	83	Possible Design of Correctional Device of a Topographic Stereometer. (Labelled Parts).
121	85	Design of Correctional Device. Based on a change of the Value f_k . (Labelled Parts).
122	86	Design of a System of Two Convergent Devices.

<u>Page</u>	<u>Figure</u>	Section 15: Designs ("Constructions") of Stereometric Instruments.
126	88	Picture: Topographic Stereometer (External View).
126	88 a	Design of Topographic Stereometer (Labelled Parts).
128	89	Picture: Stereometer (External View).
129	90	Picture: Convergent Arrangement of Stereometer. (External View).
130	91	Detail Drawing: Correctional Device of Stereometer.
130	92	Detail Drawing: Optical System of Stereometer.
		Table 15: Technical Data for (1) Topographic Stereometer, (2) Stereometer.
132	93	Picture: Kern's Stereometer (External View).
132	94	Detail Drawing: Design of Kern's Stereometer (Labelled Parts).
136	96	Detail Drawing: Design of Correctional Attachments for Solution of Fifth and Sixth Terms of Formula (67).
137	97	Detail Drawing: Design of Semi-universal Intersection.
145	98	Detail Drawing of Origination of Errors in Longitudinal Parallaxes Because of Rotation of the Negative in a Stereometer.
		Chapter 4: Devices of Direct Optical Intersection.
		Section 20: Double Projection.
150	99	Detail Drawing of Optical Direct Intersection.
152	100	Detail Drawing of Affined Projection of a Vertical (Plane) Photograph.
153	101	Detail Drawing: Affined Projection of an Oblique Photograph.
		Section 21: Sharpness of Image and Observation.
158		Table 19: Comparative Data of Resolving Power of Objectives, Calculated According to Formula 83. Objectives: "Tessar" Aerial Survey Objective; "Russar" Aerial Survey Objective;

Page Figure

		"Ortoniar" with $f = 100\text{mm}$. (projection); Multiplex with $f = 20,5\text{ mm}$. (projection); Glass for monocular view.
		Section 22: Basic Elements of Optical Projection Devices.
164	102	Detail Drawing: Simple Type. Photo-reducer. (Labelled Parts) (External view).
165	103	Detail Drawing: Photo-reducer for Preparing of Diapositives of the Multiplex. Objective (Labelled Parts)
166	104	Design of Drawing Table
		Section 23: Double Projectors.
167	105	Dimensional Data of a Number of Projectors.
168	106	Detail Drawing of Double Projector of TsNIIGAIK. (External View).
170	107	Detail Drawing of Intersection in Double Projector DPD-2.
172	108	Detail Drawing: Double Projector DPD-2.
173	109	Magazine (Casette) Section of DPD-2.
174		Table 20: Data for Double Projector DPD-2 and DPD-1.
		Section 24: Multi-chamber Projectors.
175	110	Picture: Multiplex (External View).
177	111	Base Installation of Multiplex.
178	112	Optical Design of Ultra-wide Angle Projector.
180		Table of Data for Multiplexes.
		Section 25: Adjustment and Checking Optical Projection Devices.
181	113	Detail Drawing of Adjustment of Double Projector DPD-2.

<u>Page</u>	<u>Figure</u>	
182	114	Detail Drawing of Determination of Focal Length of Lens System of Projector.
184	115	Detail Drawing of Determination of Difference of Focal Lengths of Lens Systems of Multiplex.
		Section 26: Investigation of Optical Projection Devices.
187	116	Curves of Equal Distortions of Stereomodel Because of Distortion of Projection Objectives.
188	117	Curves of Equal Illumination on Screen of a Multiplex.
		Chapter 5. Instruments for Automatization of Special Intersection by Optical-mechanical and Mechanical Methods.
		Section 27: Structure of Devices.
192	118	Drawing: Aerial Photographs and Ground-Level Photographs. Set up in the System of the First Kind.
193	120	Drawing: Aerial Photographs, Set Up in the System of the Second Kind. •
193	120	Drawing: Aerial Photographs, Set Up in the System of the Third Kind.
193	121	Drawing: Aerial Photographs Established in an Arbitrary System.
195	122	Detail Drawing of a Typical Design of a Frame with Carriage and Supports.
196	123	Ball-bearing Coupling.
196	124	Cylindrical Guide on Ball Bearings.

<u>Page</u>	<u>Figure</u>	Section 28: Instruments with Gaging Movements of Sighting Systems, in Connection with Stationary Photography.
197	125	Drawing (Design) of a Photogrammetric Theodolite.
199	126	Drawing (Design) of a Stereo-universal.
202	131	Detail Drawing (Showing Part of a Camera and Level Arm) of a Spatial Mechanical Intersection in the Case of a Movable Sighting Ray.
		Section 29: Devices with Measuring Movements of Photographs in Connection with Imovable Sighting Axes.
203	132	Detail Drawing of Formation of Distorted Cuts on a Photograph at Its Slopes in Connection with an Immovable Sighting Ray.
204	133	Detail Drawing of Special Intersection by Rotating the Camera. Labelled Parts.
205	134	Construction Design of Mechanization of Intersection when the Camera is tilted but not rotated.
206	135	Detail Drawing of Mechanization of Intersection when Negatives Are Displaced in Their Planes.
206	136	Detail Drawing of a Special Mechanical Intersection with Movement of the Photograph in its Plane in the Case of a Fixed Sighting Ray.
206	137	Detail Drawing of Formation of Intersection in the Case of an Oblique Photograph, Brought Together with the Screen to a Horizontal Position.
208	138	Detail Drawing of Solution of Spatial Mechanical Intersection when the Photograph and Plane Are in a Horizontal Position.

		Chapter 6: Universal Stereo Devices of Complicated and Simple Designs.
		Section 33: Design of Stereoplanigraph APB and S-4.
220	149	Detail Drawing of Spatial Intersection which Has the Form of a Triangle with a Parallelogram.
221	150	Design of Stereoplanigraphs SPB and S-4.
		Section 34: Structure of Mechanical and Optical Parts of Stereoplanigraphs
223	151	Picture: Stereoplanigraph SPB (External View).
224	152	Detail Drawing: Cardan Construction of Nuts of Lead Screws of Stereoplanigraph.
225	153	Drawing: Reinforcing of Cameras of Stereoplanigraph.
226	154	Drawing: Auxiliary Optical System of SPB.
227	155	Drawing: Structure of Mechanism of Auxiliary Optical System SPB (Labelled Parts).
228	156	Drawing: Observation System ((Including Objectives, Lenses, Prisms, etc.) of Stereoplanigraph SPB. (Labelled Parts).)
230	157	Drawing: Observation System (Including Objectives, Prisms, etc.) of Stereoplanigraph S-4. (Labelled Parts).
		Section 35: Adjustments and Checks of the Stereoplanigraph
234	158	Drawing of Determination of Zero Points.
235	159	Drawing of Determination of Zero Points Z and b_z .
		Section 37: Small Form Universal Devices.
240	160	Drawing of Intersection with the Unaided Eye.
241	161	Drawing of Intersection in Stereoscopic Drawing Device RP-6.
243	162	<u>Picture: Stereoscopic Drawing Device RP-6. (Labelled Parts).</u>

Source III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem.
(The Rating Methods of Complicated Photographic Systems). OGIZ 1948.

Chapter 2: Method of Classing Coefficients of Aberration of the Third Order
in Symmetrical and Quasi-symmetrical Photographic Systems which
Contain Components of Finite Thickness.

Page Figure

- | | | |
|----|-----|---|
| 31 | 1 | DRAWINGS of Optical Anastigmats (Objectives). |
| | 1-a | Ross's "Ekspress". |
| | 1-b | Audol'f's "Planar". |
| | 1-c | M. Rusinov's "Russar". |

(Note: All of these systems are combinations, consisting of two "halves", separated by air space, in which the aperture diaphragm is located).

Paragraph 1: Two Possible Cases of "Completing" Symmetrical Systems.

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| 33 | 3 | Derivation of a System in the Case where $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$. |
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Paragraph 2: Synthesis of a Symmetrical System in the Case $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$.

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| 35 | 3 | Combination X Applied as the Second Half of a Complex System. |
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Paragraph 3: Synthesis of a Symmetrical System in the Case $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$.

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| 41 | 4 | Combination X Applied as the First Half of a Complex System. |
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Paragraph 4: Quasi-symmetrical Systems.

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| 47 | 5 | Optical Design of a Quasi-symmetrical Anastigmat (Objective). |
|----|---|---|

Chapter 3. Two-Component Plane-astigmats as Elements of Complex Systems.

- | | | |
|----|---|---|
| 51 | 6 | Optical Design of the Anastigmat (Objective). "Kino-Plazmat". |
|----|---|---|

<u>Page</u>	<u>Figure</u>	
		Paragraph 1: Two Types of Plane-anastigmats (Objectives)
52	7	Combination of Type X _A
52	8	Combination of Type X _B
		Paragraph 4: Computation Investigations (Note: Figures 9-11 Computation Graphs)
69	12	Optical Design of 4-Lens Objective "Ortagoz".
69	13	Optical Design of Three-Lens Objective with Compensator for Astigmatism and Curved Field.
		(Note: Figures 14-15: Graphs of Computation Curves for Optical Systems).
		Chapter 4. Analysis of Several Present-Day Types of Complex Anastigmatic Objectives.
		Paragraph 3. Light-Powerful (of great light-gathering power) of the "Planar" type.
92	16	Optical Design of Several Anastigmats (Anastigmatic Objectives) Variation of "Planar".
92	16 a	Drawings showing Optical Design of a variation of the "Planar" anastigmatic Objective shown in Figure 1-b of this text. The variation consists of two-lens cemented components in place of the outer lens shown in figure 1-b. It is said that the possibilities of variations (field of possible re- solings) of systems of the type of Fig. 16-a are extremely varied.
	16 b	Drawing of optical Design of Merté System (a Variation of the "Planar" Anastigmat)
	16 c ("v")	Drawing showing Optical Design of Another Variation of the "Planar" Anastigmatic Objective.

<u>Page</u>	<u>Figure</u>	
164	24 _e	Drawing of Volosov Objective, a five-lens anastigmatic objective. "Sometime later (in 1937 - 1938) the author of these lines also undertook an investigation of this rather unusual design of Taylor, at the same time trying to simplify it, in particular, investigating the resolving for a five-lens design of an anastigmat".
166	25	Optical Design of the "Montar" Objective (German System). (Omitting here the exposition of the results obtained (extremely interesting), we shall point out only that a comparative and fuller evaluation of them (anastigmats) will be possible only later, when the construction of the foreign long-focus complex anastigmats will have become known and, in particular, the German Systems of the type "Zonar" and "Montar" (Fig. 17-a and 25) and the American systems of the type "Aero-Ektar" (Fig. 38)."
183	26 _a 26 _b	Diagrams of "Dispersion, Formed by Rays of Oblique Pencils..." etc.
187	27	"Graph of Aberration of Broad Pencils of Rays."
		Part 2: Method of Computing Photographic Systems with Variable Optical Characteristics
189	28	Drawing: Warmisham System. (Pr. pat. specif. 398, 807). Paragraph 1. The Area Paraxial Optics.
196 230	29 31	Diagrams: Geometrical Interpretation of Junctions; etc.
234	32	Drawing: Optical Design of System of "Idar." (Objective)

<u>Page</u>	<u>Figure</u>	
234	33	Diagrams of Computations.
268	36	
269	37	Drawing: Design of Achromatic Wide-Angle System of the Type "Hypergon" Containing Lanthanum Glasses.
282	40	Diagrams of Computations
306	46	
307	47	Drawing: Optical Design of Tele-objective "Telekon" (a K. Zeiss objective) Technical data.
309	48	Drawing: Optical Design of System of "Telefotoanastigmat" Objective.
314	49	Diagram of Computation.
327	50	Drawing: Optical Design of a Two-lens Objective with an anastigmatic Compensator.
331	51	Diagram of Computations.
348	56	
		Chapter 16. Mirror - Lens Systems.
363		Introduction.
364	57	Drawing: Mirror-Lens Double Meniscus System. (Worked out by D. S. Volosov in the beginning of 1942).
		Paragraph 1. The Meniscus Compensator.
365	58	Drawing: Design of the Meniscus Compensator.
		Paragraph 2. The "Meniscus Compensator - Spherical Mirror" System.
373	59	Drawing: Design of the "Meniscus Compensator Spherical Mirror System."
377	60	Graph of Dependence of Coefficient K on the Relative Aperture of the Meniscus System.

<u>Page</u>	<u>Figure</u>	
		Paragraph 4. The "Two-lens Afocal Compensator - Spherical Mirror" System.
386	61	Drawing: Design of the "Two-lens Afocal Compensator - Spherical Mirror System.
389	62	Drawing: The Two-mirror System with Afocal Compensator.
		Paragraph 5. Elimination of "Lighting of the Image" (Parasitic lighting) in Mirror - Lens Photographic System.
390	63	Drawing: A Meniscus Tele-objective. (Showing a second possible solution to the problem of eliminating "parasitic" lighting ((Absence of direct falling of the rays onto the photographic film)). Recommended by D. D. Maksutov by means of a supplementary reproducing System (D in Figure 63)
391	64	Drawing: Mirror-lens System with Finite Diaphragm.

Source IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952. DLC: QC 355.T832 (P 694, MF #278-A).

Chapter 16. The Photographic Objective

<u>Page</u>	<u>Figure</u>	<u>Information Available</u>
106	305	Drawing: Design of "Tessar" Type Objective with Focal Length - 174.74 and Relative Aperture 1:4.5.
133	320	Picture of "Universal Device" (for testing objectives and with special attachments for application of the J. Hartmann Method) of the "Askaniya" Firm.
173	331	Picture: Four Interferograms of "Tvayman" Obtained With a "Tessar" Objective (Focal Length = 210 mm., Relative Aperture 1:4.5).

Section 228. Survey of the Main Types of Photographic Objectives.

177	332	Drawing: Design of the "Petsval" Objective. Built in 1840 using Fetsval's computations. The first "powerful in light-gathering" objective. Data: $f/3.5$, $2\beta = 20-30^\circ$.
177	333	Drawing: Design of Symmetrical Objective of A. Shteyngeyl' (1865). Consists of 2 meniscuses with a diaphragm between them.
177	334	Drawing: Design of "Hypergon" Objective. This is a wide-angle objective manufactured by the firm of Hertz ("Gerts"). The designer, in 1900, was "Gyëyeg." (This is said to be "the first orthoscopic wide-angle objective").
178	335	Drawing: Design of "Aplanat" Objective. This represents "a perfectly natural transition from the symmetrical design

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| <u>Page</u> | <u>Figure</u> | <p>type which could not be corrected for astigmatism. The double objective has a relative aperture of 1:5.8 and a field of view of about 60° with full aperture. This objective enjoyed great popularity and retained its significance until recently (up to the time when the Hertz firm shut down); "in the first decade of the 20th Century, it was manufactured in Russia, in Warsaw, by the 'Fos' firm, which had received the right to produce it under another name: 'Planastigmat Fos'".</p> |
| 180 | 339 | <p>Drawing: Design of a Double Anastigmat, Composed of Two Un-identical "Protar" Lenses. (As for the "Protar" - "there exist a large number of symmetrical anastigmats, consisting of two halves, of which each is cemented out of more than three lenses").</p> |
| 181 | 340 | <p>Drawing: Design of the "Planar" of K. Zeiss, computed in 1896 by Rudol'f, which may be considered as the first representative of the second group of symmetrical uncemented anastigmats.</p> |
| 181 | 341 | <p>Drawing: Design of the "Tselor" Objective of the Hertz Firm, worked out by Gyëyeg in 1898. This is said to be a simpler design of the symmetrical anastigmats and that type are said to be very great in number.</p> |
| Section 229. | | <p>Objectives with a Large Field of View.
(<u>Wide-angle Objectives</u>).</p> |
| <p>(Note: See also the "Hypergon", Fig. 324 on Page 177).</p> | | |
| 183 | 342 | <p>Drawing. Design of the Zeiss "Topogon". This is a development and perfection of the orthoscopic wide-angle objective.</p> |

- | <u>Page</u> | <u>Figure</u> | |
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| | | This objective has the following characteristics: $f/6.3$, $2\beta = 90^\circ$, Focal Length: 150 mm. |
| 183 | 343 | Drawing: Design of "Liar-6" Wide-angle Objective, an M. M. Rusinov Objective. Data: Focal Length 100 mm., $f/5.4$ and $2\beta = 104^\circ$. |
| 183 | 344 | Drawing: Design of "Russar-25" (a M. M. Rusinov Objective). Characteristics: Focal Length 100 mm., $f/6.3$, $2\beta = 110^\circ$. |
| 183 | 345 | Drawing: Design of "Express" of Ross (a Wide-angle Objective, which, in Addition to "Ortometar" of Merté (K. Zeiss) of Almost Identical Construction, Has a Significant (Rather High) Light Gathering Power and a Good Correction of Distortion. Data: $f/4.5$, $2\beta = 70^\circ$. |

(Note: On page 183, it is stated: "There are a small group of wide-angle objectives in which distortion not only is not corrected, but, on the contrary, occurs up to very great values with the aim of significantly diminishing the angle between the main rays and the axis after their emergence from the center of the outlet pupil in comparison with those same angles in space of objects".).

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| 183 | 346 | Drawing: Design of the Hill ("Gill") Objective. Data $f/22$, $2\beta = 180^\circ$. |
| 184 | 347 | Drawing: Design of the Schulz ("Shul'ts") Objective. Data: Focal Length 35 mm., $f/5.6$, $2\beta = 135^\circ$. |
| 184 | 348 | Drawing: Design of the "Pleon" Objective. Data: Focal Length 72.5 mm., $f/8$, $2\beta = 130^\circ$. (Six lenses and plane-parallel plate of colored glass). |

Section 230. "Powerful in Light-gathering" ("Svetosil'nyye") Objectives.

Note: The first of these objectives was the very old "Petstval" objective. See Figure 332, page 177 of this volume.

Page Figure

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| 185 | 349 | Drawing: Design of the "Biotar" Objective. "In 1911 Rohr increased the relative aperture of the "Petsval" Objective to $f/2$ by the addition of a negative lens, placed almost in the focal plane in front of the light-sensitive coating, as can be seen from the design of the objective in Figure 349; this objective, called "Biotar", had no practical value; its 2β did not exceed 20° ". |
| 185 | 350 | Drawing: Design of the "Ernostar" Objective. "In 1924 the Erneman firm produced the "Ernostar" Objective, computed by Bertele with $f/1.3$, of relatively complex design, as can be seen in Figure 350; 2β = about $35-40^\circ$. The objective occupied a well-known place on the market: the "Ermanoks" camera with this objective for night exposures was produced by the firm of "Zeiss-Ikon." |
| 185 | 351 | Drawing: Design of the G. G. Slyusarev Objective. "In 1922 such an objective was computed by G. G. Slyusarev; one experimental model was prepared with a good result. Objectives which were very close to this design were produced in Europe and America some time later under the name "Takhar". In 1933 the objective of G. G. Slyusarev, which preserved the type, was perfected, while its 2β was brought to $45-50^\circ$; the design of this objective is given in Figure 351". |
| 185 | 352 | Drawing: Design of the "Kinoplasmat" of Rudol'f. "The symmetrical designs were adapted for computation of the "powerful in light-gathering" objectives by various firms. Thus, |

Page Figure

- for example, "Kinoplasmat" of Rudol'f, of the Hugo Mayer Firm has a design, represented in Figure 352; Data: $f/2$."
- 185 353 Drawing. Design of "Biotar" Objective. "In 1927 the K. Zeiss Firm produced a "powerful in light-gathering" objective under the former name "Biotar", computed by Merte', with $f/1.4$ and small 2β - not more than 30° . As can be seen in Figure 353, the design of this objective is very complex."
- 186 354 Drawing: Design of one of the Variants of the Compound Anastigmat "Uran" Type (D. S. Volosov). Data: Focal Length - from 25-500 mm., $f/2$ to $f/3.5$ and 2β from $40-63^\circ$.
- 186 355 Drawing: Design of the "Aeroektar" Objective of the "Kodak" Firm. Data: Focal Length 175 mm., Relative Aperture $f/2.5$ and $2\beta = 50^\circ$.
- 186 356 Drawing: Design of a Variant of "Ektar" Objective of "Kodak" Firm. Data: $f/1.5$.
- 186 357 Drawing: Design of the "Zonnar" Type Objective of the K. Zeiss-Ikon Firm. Data: Focal Length 50 mm., $f/1.5$ and $2\beta 46^\circ$. Note: These are made also with $f/1.4$ to $f/2$ and $f/2.8$.
- 187 358 Drawing: Design of a "Mirror-Lens Objective, Computed by D. S. Volosov, D. Yu. Gal'pern and Sh. Ya. Pechatnikova." Data: $f/1.4$, $2\beta = 15^\circ$.
- 187 359 Drawing: Design of One of the "New Mirror-Lens Objectives Considered in an Article by J. Flügge...of the Bush Firm" Designer: "Veydert"). Data: Nominal $f/0.9$, Equivalent (Effective) Aperture $f/1:1.15$ and $2\beta =$ about 34° .

Section 231. Teleobjectives.

Page Figure

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| 188 | 361 | Drawing: "Design of Teleobjective of Bush 'Bistellar'."
Data: $f/7$, 2β = about 300° , Focal Distance 1:2. |
| 188 | 362 | Drawing: "Design of the 'Magnar' Objective of the K. Zeiss Firm." Data: $f/10$, 2β = not above 150° , Focal Distance 1:4. |
| 189 | 363 | Drawing: "Design of the 'Teletessar' of the Zeiss Firm."
Data: $f/6.3$, 2β = about $35-400^\circ$. |
| 189 | 364 | Drawing: "Design of the 'Telekon' Teleobjective of the K. Zeiss Firm." Data: $f/6.3$, Focal Length 1:2.44, Distortion does not exceed 0.2%, and 2β reaches 300° . |
| 189 | 365 | Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/8$. |
| 189 | 366 | Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/5.6$. |

Section 233. Objectives for Aerial Photography

Note: There are no "pictures" or "diagrams" or "drawings" of objectives in this section but the following statement is made:

- 193 "Of the objectives mentioned earlier the following are used for geodetic operations: 'Tessar' with focal length = 250 mm. and $f/4.5$; 'Dagor' ($f' = 150$, $f/6.8$, 2β about 680°); 'Ortometar' ($f' = 135$, $f/4.5$, 2β up to 700°); Ross 'Ekspress' ($f' = 150$ and 200 mm., $f/4$, 2β up to 800°). The use of wide-angle objectives for geodetic purposes provides great economic savings (profits), since it makes possible decreasing the number of pictures necessary to obtain a map of a given section of a locality; therefore, for this purpose the following are used: 'Metrogon', very near to the 'Topogon', and the wide-angle objectives of M.M. Rusinov of the 'Russar' Typ

Source V. Katalog - Spravochnik Laboratornykh Priborov i Oborudovaniya.
Vypusk 34. Mashgiz, 1949

Geodezicheskiye i Fotogrammetricheskiye Pribory.

Pages

- 5-8 Stereoplanigraph ("Stereoplanigraf"). Manufacturer: Armaments Ministry of USSR Plant ("Zavod Ministerstva Vooruzheniya SSSR") Text: Pages 5-8.
- 5 "Stereoplanigraf" - Picture of Apparatus.
- 6 "Stereoplanigraf" - Lateral View, Labelled Parts.
- 7 "Stereoplanigraf" - Detail Drawing of Working Parts.
- 7 "Stereoplanigraf" - Detail Drawing of Prisms, Numbered.
- 8 "Stereoplanigraf" - Technical Data.
- 9-10 Large Photo-rectifier FTB. Manufacturer: Armaments Ministry of USSR Plant. (Bol'shoy Fototransformator FTB)
- 9 Picture of above.
- 10 Technical Data.
- 11-13 Stereocomparator SK 18 x 18. Manufacturer: Armaments Ministry of USSR Plant. (Stereokomparator SK 18 x 18)
- 11 Picture of External View, Labelled Parts.
- 12 Detail Drawing of Working Parts.
- 13 Technical Data.
- 14-17 Precision Stereometer SM -3. Manufacturer: Armaments Ministry of USSR Plant. (Pretsizionnyy Stereometr SM - 3).
- 14 Picture of External View, Labelled Parts.
- 15 Detail Picture, Labelled Parts.
- 17 Technical Data.

Pages

- 18-21 Drobyshhev's Stereopantometer SPD -1. ("Stereopantometr SPD -1 Drobysheva")
- 18 Picture: External View.
- 19 Detail Drawing of Working Parts, Labelled Parts.
- 20 Detail Drawing, Labelled Parts.
- 21 Technical Data. Manufacturer: Plant of Main Administration of Geodesy and Cartography under the Council of Ministers of the USSR.
- 22-24 Konshin's Stereoscopic Drawing Device RP - 5. (Stereoskopicheskiy Risoval'nyy Pribor RP - 5 Konshina). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 22 Picture: External View.
- 23 Picture: (Head of View), Labelled Parts.
- 24 Technical Data.
- 25-28 Drobyshhev's Topographic Stereometer STD -1. ("Topograficheskiy Stereometr STD - 1 Drobysheva"). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 29 Picture: External View with Labelled Parts.
- 30 Technical Data.
- 31-32 Russar - 29. Aerial Photo Objective with ZV -1 Shutter. ("Aerofotoob'yektiv Russar - 29 s Zatvorom ZV-1")
- 31 Picture: External View.
- 31 Picture: Internal View with Labelled Parts.
- 32 Technical Data. Manufacturer: Laboratory of Main Administration of Geodesy and Cartography.
- 33-36 Multiplex Aeroprojector. ("Aeroprojektor Multiplex"). Manufacturer: Laboratory of Main Administration of Geodesy and Cartography.

Pages

- 33 Picture: External View.
- 34 Picture: "Stupped" View Showing Labelled Parts.
- 34 Detail Picture showing Labelled Parts.
- 35 Detail Drawing and Picture showing Labelled Parts.
- 36 Technical Data.
- 37-38 Astronomic Universal 5" ("Astronomicheskiy Universal 5"). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 37 Picture.
- 38 Technical Data.
- 39-40 Optical Theodolite, Medium, "OTS". ("Opticheskiy Teodolit Sredniy OTS") Manufacturer: Plant of Ministry of Armaments of the USSR.
- 39 Picture.
- 40 Technical Data.
- 41-42 Optical Theodolite Small "OTM". ("Opticheskiy Teodolit Malyy OTM") Manufacturer: Plant of Ministry of Armaments of the USSR.
- 41 Picture.
- 42 Technical Data.
- 43-45 Optical Theodolite "OT-10". ("Opticheskiy Teodolit OT-10").
- 43 Picture.
- 45 Technical Data.
- 46-47 Theololite - Tachimeter "TT-2". (Teodolit - Takheometr TT-2")
- 46 Picture.
- 47 Technical Data
- 48-49 ~~Mining~~ Theodolite TG-3. ("Gornyy Teodolit TG-3"). Manufacturer: Plant of Ministry of Coal Industry of the USSR.

Pages

- 48 Picture.
- 49 Diagram of Working Parts.
- 50 Technical Data.
- 51-52 Pilot Balloon Theodolite "ShT". ("Sharopilotnyy Teodolit ShT").
Manufacturer: Plant of Ministry of Armaments of the USSR.
- 51 Picture.
- 52 Technical Data.
- 53 Mining Compass "KG-1" ("Kompas Gornyy KG-1"). Manufacturer: Plant
of Ministry of Armaments of the USSR.
- 53 Picture. Technical Data.
- 54 Orienting Compass, "BG-1". ("Orientir - Bussol' BG-1"). Manufac-
turer: Plant of the Ministry of Armaments of the USSR.
- 54 Picture. Text. Technical Data.
- 55 Large Compass "BSh-1". ("Bussol' BSh-1"). Manufacturer: Plant of
the Ministry of Armaments of the USSR.
- 55 Picture. Text. Technical Data.
- 56-57 Large Alidade "KB". ("Kipregel' Bol'shoy KB"). Manufacturer:
Plant of the Ministry of Armaments of the USSR.
- 56 Picture.
- 57 Technical Data.
- 58-59 Automatic Alidade VKS-7 of Stodolkevich. ("Kipregel'nyy Vysotomer
VKS-7 Stodolkevicha") Manufacturer: Plant of Main Administration of
Geodesy and Cartography.
- 58 Picture (External View) and Picture (External View) with Labelled Parts.
- 59 Labelled Pictures of Working Parts (Internal View). Detail Picture of
the Registering Mechanism. Detail Picture of Optical "Wedge".
- 59 Technical Data.

Pages

- 60-61 Optical Mining Transit. ("Uglomer Opticheskiy"). Manufacturer: Plant of the Ministry of the Coal Industry of the USSR.
- 60 Picture (External View). Drawings: Working Parts of this Mining Transit.
- 61 Technical Data.
- 62-63 Auxiliary Equipment with Mining Transit KU. "Komplekt Uglomera KU". Manufacturer: Plant of the Ministry of Coal Industry of the USSR.
- 62 Picture (External View) with Labelled Parts.
- 63 Picture: Labelled Parts. Technical Data.
- 64-65 Solar Shadow Course Indicator STU-L-5. ("Solnechnyy Tenevoy Ukazatel' Kursa STU-L5"). Manufacturer: Plant of the Main Administration of Geodesy and Cartography.
- 64 Picture: External View with Labelled Parts.
- 65 Technical Data.
- 66 Block Plumb Bob BO-1. ("Blochnyy Otves BO-1"). Manufacturer: Plant of the Ministry of the Coal Industry of the USSR.
- 66 Picture (External View) with Labelled Parts. Technical Data.
- 67 Mirror Optical Square (T-square) ("Ekker Zerkal'nyy EG-1") Manufacturer: Plant of the Armaments Ministry of the USSR.
- 67 Picture (External View) Technical Data.
- 68-70 Precision Dumpy Level NPG. ("Nivelir Pretsizionnyy Glukhoy HPG"). Plant of the Main Administration of Geodesy and Cartography.
- 68 Picture of External View, Labelled Parts.
- 69 Drawings of Details. Labelled Parts.
- 70 Technical Data.
- 71-72 Precision Level HA-1. ("Nivelir Pretsizionnyy NA-1"). Manufacturer: Plant of the Armaments Ministry of the USSR.

Pages

- 71 Picture of External View.
- 72 Technical Data.
- 73 Engineering Level NT. ("Tekhnicheskiy Nivelir NT") Manufacturer: Plant of the Armaments Ministry of the USSR.
- 73 Picture of the External View. Technical Data.
- 74 Dumpy Level NG. ("Glukhoy Nivelir NG"). Manufacturer: Plant of the Armaments Ministry of the USSR.
- 74 Picture of the External View, Labelled Parts.
- 75 Picture of Internal View , Labelled Parts.
- 76-77 Mining Level with Removable Tube. ("Gornyy Nivelir s Perekladnoy Truboy"). Manufacturer: Plant of the Coal Industry Ministry.
- 76 Picture of the External View. General Drawing with Labelled Parts.
- 77 Technical Data.
- 78-79 Artanov's Automatic Level. ("Nivelir Avtomat Artanova"). Manufacturer: Scientific Research Institute of the Ministry of Communications.
- 78 Picture of the External View. Picture of Internal View with Labelled Parts.
- 79 Picture of External View. Technical Data.
- 80-81 Profile-graph of Artanov. ("Profilograf Artanova"). Manufacturer: Scientific Research Institute of the Ministry of Communications.
- 80 Picture: External View. Picture: External View of the Details.
- 81 Drawing with Labelled Parts. Technical Data.
- 82-83 Artanov's Planigraph. ("Planigraf Artanova"). Manufacturer: Scientific Research Institute of the Ministry of Communications.
- 82 Picture of the External View.

Pages

- 83 Drawing with Labelled Parts. Technical Data.
- 84-85 Pantograph. "(Pantograf Gornyy)". Manufacturer: Plant of the
Ministry of Coal Industry.
- 84 Picture: External View. Drawing with Labelled Parts.
- 85 Technical Data.
- 86-87 Road Measurer. ("Putimetr"). Manufacturer: Scientific Research
Institute of the Ministry of Communications.
- 86 Picture: External View. Drawing with Labelled Parts.
- 87 Technical Data.
- 88 Route Measurer. ("Kurvimetr" KBM). Manufacturer: Plant of the
Armaments Ministry of the USSR.
- 88 Picture: External View. Technical Data.
- 89 Drobyshv's Rule. ("Lineyka Drobysheva LD-1"). Manufacturer: Plant
of the Ministry of Coal Industry.
- 89 Picture of External View. Labelled Parts. Technical Data.
- 90 Straightedge for Plotting of Coordinate Nets. ("Lineyka dlya nan-
eseniya Koordinatnykh Setok LBL"). Manufacturer: Plant of the
Armaments Ministry of the USSR.
- 90 Picture of External View.
- 91 Technical Data.
-

Source VI. 20th Anniversary of Soviet Geodesy and Cartography, 1919-1939.
(Dvadtsat' Let Sovetskoy Geodezii i Kartografii, 1919-1939.)

Geodetic Instruments.

<u>Pages</u>	<u>Figures</u>	
108	1	Topographical Stereoscope for the Reciprocal Orientation. "Tors". ("Topograficheskiy Stereoskop dlya Opredeleniya Elementov Vzaimnogo Orientirovaniya, Tors").
108	1	Picture of External View.
109	2	Aerial Surveying Stereocomparator. ("Aeros'emochnyy Stereoskop")
109	2	Picture of External View.
111	3	Topographical Stereometer "STD-1". ("Topograficheskiy Stereometr STD-1")
111	3	Picture of External View.
112	4	Topographical Stereometer "TSD-3". ("Topograficheskiy Stereoskop TSD-3")
112	4	Picture of External View.
113	5	Stereoscope "Cyclope". ("Stereoskop Tsiclop").
113	5	Picture of External View.
114	6	Precision Stereometer "SM-3". ("Pretsizionnyy Stereometr SM-3").
114	6	Picture of External View.
115	7	Drawing Device. ("Risoval'nyy Pribor").
115	7	Picture of External View.
190	2	Universal Theodolite of 5" Accuracy. ("Universal 5", Tochnosti").

<u>Pages</u>	<u>Figures</u>	
190	2	Picture of External View.
192	3	Triangulation Theodolite of 2" Accuracy. ("Triangulatsionnyy Teodolit 2" Tochnosti").
192	3	Picture of External View.
194	4	Astronomic Universal of 2" Accuracy. ("Astronomicheskiy Universal 2" Tochnosti").
194	4	Picture of External View.
195	5	Precision Level. ("Pretsizionnyy Nivelir").
195	5	Picture of External View.
196	6	Topographical Stereometer. ("Topograficheskiy Stereometr").
196	6	Picture of External View.
197	7	Four Pendulum Support. ("Chetyrekhmayatnikovyy Shtativ").
197	7	Picture of External View.
199	Table	Data on the Quality of Limb Graduation of Theodolites of Several Types.
384		Picture: External View of the Comparator of the Jäderin Apparatus.
392		Picture: General View of the Gravimetric Variometer. (V Gravimetricheskoy Laboratorii. Rabota s Variometrom).

Source VII: Shershen', A.I., Aerofotos"venka, Letnos"yemochnyy Protsess (Aerial Photography, Aerial-Surveying Process), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1949.

Text	(Data) Figure or	Page Table No.	Information Available
23	13	<p>Picture. External View of So-called "Nine-Objective Aerial Camera 'AD-1' and 'AD-2'" ("Devyatib"yektivnyy Aerofotoapparat"). Designed by F. V. Drobyshev in 1932. The optical axes of the eight lateral lenses of this camera form 45° angles with the optical axis of the central lens. The objectives used are of Soviet manufacture with a focal length of 135 mm. and a negative size of 12 x 12 cm. The over-all angle of view of the outfit along the length and width of the course reached 140°. The distance between the aerial surveying routes with 40% overlapping exceeded the flight altitude by two times. After rectifying the oblique photographs into the projection of the plane one the over-all photograph of one exposure assumes the form of an octagon with the sides of a square inscribed in it equal to 50 cm. (See figures 14 and 14a). The camera is loaded with aerial film for 150 exposures. The winding of it and the setting into motion of the central shutters were accomplished by hand, by means of two hand wheels. The over-all weight of the camera was about 55 kg.</p>	

Text	(Data) Figure or	Page Table No.	Information Available
26	15	Picture. External View of So-called "Wide-Angle Adapter for Aerial-Camera FMK C-3" ("Shirokopolosnaya Nasadka k Aerofotoapparatu FMK C-3").	
27	16	Drawing Showing the Working Parts of the "Wide-Angle Adapter", the External View of Which is Shown in Fig. 15. In 1932, the Leningrad Scientific-Research Institute of Aerial Surveying (Leningradskiy Nauchno-issledovatel'skiy Institut Aeros"yemki) worked out an original optical attachment for a single-objective aerial camera, which made it possible to do plane-oblique photography without changing the position of the optical axis of the camera. This attachment, called by its designer Yu. K. Yutsevich "a wide-angle adapter", was placed in front of the objective of the usual camera and increased the field of view along the course up to 122°. A similar wide-angle adapter for aerial-camera FMK C-3 and its working principle are shown in figures 15 and 16."	
31	22	Picture. External View of Aerial Camera ("Aerofotoapparat") "AFA-13".	
"The first Soviet automatic aerial-camera 'AFA-13', manufactured by the 'Geodeziya' plant, was equipped with a new high-quality aerial photography objective with the brand name 'Industar-13' with a focal length of 300 mm			

Text (Data)	Figure or Table No.	Information Available
		<p>and a relative aperture of $f/4.5$. 'AFA-13' (Fig. 22) was activated by an electric motor operating on direct current with a voltage of 12 volts. The cassette contained 150 negatives 18 x 18 cm. in size. The film was aligned by means of the creation of a vacuum by a special suction device. The apparatus was equipped with a between-the-lens shutter of the Jalousie type, with exposure speeds of from 1/75 to 1/200 sec. and was operated by means of an intervalometer with a diapason of intervals between exposures of from 5 to 60 sec. A signal light for verifying the action of the mechanism of the cassette and a counter of the number of aerial photographs made lightened the work. A second counter was included in the camera and its indications were shown on each picture. The aerial mount of the Cardan type had rubber shock absorbers. 'AFA-13' was intended for plane surveying for purposes of military reconnaissance. It replaced the 'Potte' apparatus which had formerly been used for that purpose."</p>
33	23	<p>Picture. External View of Aerial Camera (and Attachments) ("Aerofotoapparat") "MAFA-13".</p> <p>"Later the AFA-13 was modernized. It was equipped with a short-focus objective 'Iussar-1', with a corresponding</p>

Text (Data) Page	Figure or Table No.	Information Available
		<p>alteration of the camera section. Other changes were also introduced into its design: the Jalousie shutter was replaced with a central shutter GOMZ, a liquid statoscope (of the D.I. Mendeleev type) was used, the readings of which were indicated on each photo; the winding of the aerial film was improved by means of a supplementary negative system, etc. This apparatus under the name 'NAFA-13' (Fig. 23) was used in such a form in aerial (flying) survey work until additional improvements were made. At length the focal plane was moved out of the cassette into the camera and the GOMZ shutter was replaced by a central shutter of the 'SV-1' type, designed by the Soviet engineer Vertiporokh."</p>
71	43	<p>Drawing. Working Parts of a Two-Slit camera (Aerial Camera) of the "AShchAFA-2" Type.</p> <p>This type of two-slit camera is said to have "an important advantage over the one-slit apparatus. It makes it possible to photograph at the same time in two scales: in the larger scale -- with objective O_1 of the 'Plazmat' type, with $k = 210$ mm ($1:n = 1:3.5$, $2 = 600$), through slit z_1, and in a smaller scale -- with a wide-angle objective O_2 of the 'Russar-2' type, through slit z_2."</p> <p>Use of aerial film of a width of 25 cm.</p>

Text (Data) Figure or Page Table No.	Information Available
135 71	Picture. External View of Range Finder "OPB-IM". Field of View of the order of 30°.
136 72	Drawing. Working Parts of the Range Finder "OPB-IM", the External View of Which is Shown in Fig. 71.
137 74	Drawing. Detail Drawing Showing Gauges and Scales of the Supporting Installation for the Range Finder "OPB-IM".